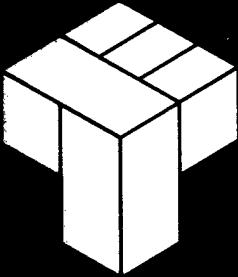


Einhorn
Yaffee
Prescott



ARCHITECTURE &
ENGINEERING, P.C.

Final Submittal

FAMILY HOUSING INSULATION ENERGY CONSERVATION OPPORTUNITY (ECO) STUDY

Ft. Belvoir, Virginia

**Department of the Army
Baltimore District
U.S. Army Corps of Engineers**

**COE Project No. DACA 31-92-D-0061
Delivery Order NO. 0005**

EYP Project No. 60592.00

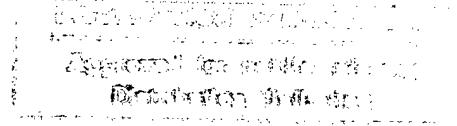
NOVEMBER 1, 1995

EXECUTIVE SUMMARY

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I. EXECUTIVE SUMMARY

A. INTRODUCTION

Six (6) family housing groups on the installation of Ft. Belvoir, including both detached and duplex type housing units, have been selected as 'prototypes' for this limited scope energy study. In general, these housing units are in good condition, but are not energy efficient by today's standard. In order to meet the requirements of Executive Order 12902 (March 8, 1994): Energy Efficiency and Water Conservation at Federal Facilities', various types of passive and active energy conservation measures were selected for detailed study to determine their viability based on life cycle cost analysis. 'Active' measures include those which require the installation of new or replacement electrical/mechanical equipment which would improve the energy performance of the operation of housing units as a whole, such as high efficiency lighting fixtures, programmable thermostats and whole house fans, etc. 'Passive' measures include those which improve the thermal characteristics of the structure, such as addition of insulation to exterior walls/attic/crawl space, addition of storm windows or replacement of single pane with double pane type, etc.

The intent of the study is to establish the current level of energy consumption for each of the prototype housing groups ('baselines'), and to recommend energy conserving options, known as 'Energy Conservation Opportunities' (ECOs), which demonstrate through heating and cooling load calculations and life cycle cost simulations to be economically viable. The ECOs which meet the criteria of Energy Conservation Investment Program (ECIP) are then packaged for funding requisition purposes, and recommendations for these prototypes may be applied to other housing groups on base with similar characteristics and projected performance.

ECIP analysis summaries for ECOs evaluated and recommended are included in this study and may be found in the Appendices.

B. PROJECT SUMMARY

Of a total of eleven(11) potential ECOs analyzed in this study, six(6) are being recommended for ECIP implementation for applicable housing groups:

- Insulation of exterior walls
- Insulation of floor over unheated crawl spaces
- Selective installation of high efficiency fluorescent light fixtures
- Reactivation of existing whole house fans or installation of new ones
- Installation of programmable thermostats
- Insulation of domestic water heaters in unheated crawl spaces

19971016180

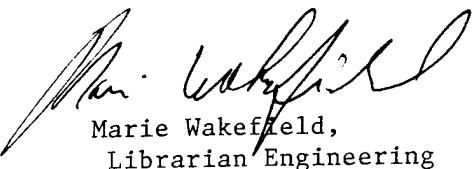


DEPARTMENT OF THE ARMY
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Marie Wakefield,
Librarian Engineering

Each of the housing areas was analyzed using the 'Multiple ECO' simulation of the ASEAM routine. The resultant projection in energy savings therefore do reflect the synergistic effect of the implementation of multiple ECOs.

The recommended ECOs have been packaged into seven(7) ECIP projects (two projects for the 'RIVER VILLAGE 1600 AREA' group, one for each of the other groups). This packaging approach makes it possible to compute the 'Savings-to-Investment Ratio' (SIR) and the payback period, with appropriate consideration of the synergistic effect. With all recommended ECOs implemented, the projected savings in energy for these six housing groups would be **13,161 MBtu** per year, or **24.5%** of the existing level. The savings in energy costs would be **\$ 171,686** per year, or **24.9%** of the existing level. The total cost of the seven ECIP packages, including SIOH and design fee, is **\$ 827,784**, for an average simple payback of 5 years.

Itemized energy/energy cost savings, first costs and SIR/pay backs for each housing group are included in TABLE 1: 'LIST OF ECO'S RECOMMENDED FOR IMPLEMENTATION' of the Executive Summary.

C. ENERGY CONSERVATION ANALYSIS

1. ECOs Investigated

A number of energy conservation opportunities (ECOs) have been investigated to determine their potential for more detailed analysis as described in this study:

a. HVAC Equipment and Controls:

- Furnace/air-conditioning system
- Attic ventilation system
- Whole house ventilation system
- Domestic water heaters
- Programmable thermostats

b. Weatherization:

- Insulation of envelope (wall, roof/attic, floor over crawl space, etc.)
- Storm windows and storm doors
- Weatherstripping
- Shading

c. Lighting:

- New fixtures
- Re-lamping of existing fixtures

2. ECOs Rejected

The following is a listing of the ECOs rejected after investigation. Explanations of rejection are provided in section 'IV. BUILDING ANALYSIS'.

a. HVAC Equipment and Controls:

- Furnace/air-conditioning unit replacement
- New attic ventilation fans
- Domestic water heater replacement

b. Weatherization:

- Add storm windows and storm doors
- Add weatherstripping
- Add Shading
- Insulate basement Walls

c. Lighting:

- Re-lamping of existing fixtures

3. ECOs Recommended

Based on:

- a. Initial cost of each Energy Conservation Opportunity (ECO) as determined through local market research;
- b. Result of computer modeling of building air-conditioning and heating energy calculation program **ASEAM** and
- c. Result of life cycle cost analysis program **BLCC**

The following ECOs are recommended for implementation through the Energy Conservation Investment Program (ECIP) projects. Each of these ECOs has a Savings-to-Investment Ratio (SIR) of 1.25 or higher, and therefore meets the ECIP requirement. Energy and energy cost savings shown are for each housing unit group.

TABLE 1: List of ECO's Recommended for ECIP Projects

| ECO Description | 1995 Cost (Including SIOH, Design (\$)) | 1995 Energy Cost Savings (\$) | 1995 Energy Savings (MBTU/YR) | | | SIR | Simple Payback Period (Year) |
|--|---|-------------------------------|-------------------------------|-------|-------|------|------------------------------|
| | | | Elec | Gas | Total | | |
| GERBER VILLAGE - 100 Area - No Basement (22 Units) | | | | | | | |
| 1. Insulate Exterior Walls | 95,524 | 11,264 | 433 | 600 | 1,033 | 1.9 | 8.5 |
| 2. Insulate over crawl space | 17,380 | 4,642 | 156 | 311 | 467 | 4.3 | 3.8 |
| 3. Replace 3 Light Fixtures with Fluorescent type | 7,766 | 815 | 54 | (-22) | 32 | 1.5 | 9.5 |
| 4. Activate whole house fan and install programmable thermostats | 14,542 | 11,462 | 560 | 264 | 824 | 12.0 | 1.3 |
| ECIP Project No. 1: Multiple ECO's 1 to 4 | 135,200 | 28,183 | 1,404 | 1,327 | 2,731 | 3.5 | 4.8 |
| GERBER VILLAGE - 100 Area - With Basement (36 Units) | | | | | | | |
| 1. Insulate Exterior Walls | 129,709 | 18,000 | 688 | 972 | 1,660 | 7.2 | 2.2 |
| 2. Insulate over crawl space | 22,498 | 4,176 | 150 | 185 | 335 | 2.9 | 5.4 |
| 3. Replace 3 Light Fixtures with Fluorescent type | 12,701 | 1,260 | 92 | (-35) | 57 | 1.4 | 10 |
| 4. Activate whole house fan and install programmable thermostats | 23,789 | 18,828 | 857 | 623 | 1,480 | 12.2 | 1.3 |
| ECIP Project No. 2: Multiple ECO's 1 to 4 | 188,698 | 50,276 | 2,092 | 2,221 | 4,313 | 4.4 | 3.8 |

| ECO Description | 1995 Cost (Including SIOH, Design (\$)) | 1995 Energy Cost Savings (\$) | 1995 Energy Savings (MBTU/YR) | | | SIR | Simple Payback Period (Year) |
|--|--|--|----------------------------------|------------|------------|------------|---------------------------------------|
| | | | Elec | Gas | Total | | |
| 166-171 AREA - (12 Units) | | | | | | | |
| 1. Insulate Exterior Walls | 36,516 | 4,404 | 172 | 228 | 400 | 1.9 | 8.3 |
| 2. Insulate over crawl space | 5,591 | 1,596 | 62 | 82 | 144 | 4.5 | 3.5 |
| 3. Replace 3 light fixtures with fluorescent type | 4,234 | 420 | 27 | (-)9 | 18 | 1.1 | 10.1 |
| 4. Activate whole house fans and install programmable thermostat | 11,088 | 4,392 | 164 | 114 | 278 | 6.1 | 2.5 |
| ECIP Project No. 3 Multiple ECO's: 1 to 4 | 57,429 | 10,176 | 475 | 316 | 791 | 2.7 | 5.6 |
| T-400 AREA - T - SHAPE (20 Units) | | | | | | | |
| 1 Replace 3 Light Fixtures with Fluorescent type | 7,056 | 940 | 63 | (-)27 | 36 | 1.3 | 7.5 |
| 2. Insulate water heaters | 941 | 360 | 0 | 61 | 61 | 6.6 | 2.6 |
| 3. Install new whole house fans and programmable thermostat | 25,379 | 7,240 | 364 | 137 | 501 | 4.3 | 3.5 |
| ECIP Project No. 4: Multiple ECO's 1 to 4 | 33,380 | 8,465 | 421 | 175 | 596 | 3.8 | 3.9 |

| ECO Description | 1995 Cost (Including SIOH, Design (\$)) | 1995 Energy Cost Savings (\$) | 1995 Energy Savings (MBTU/YR) | | | SIR | Simple Payback Period (Year) |
|--|---|-------------------------------|-------------------------------|-------|-------|-----|------------------------------|
| | | | Elec | Gas | Total | | |
| T-400 AREA 'L' SHAPE (14 Units) | | | | | | | |
| 1. Insulate over crawl space | 21,210 | 6,510 | 231 | 483 | 659 | 4.9 | 3.3 |
| 2. Insulate water heaters | 659 | 258 | 0 | 43 | 43 | 6.8 | 2.6 |
| 3. Replace 3 light fixtures with Fluorescent type | 4,939 | 630 | 44 | (-)23 | 21 | 1.8 | 7.9 |
| 4. Install new whole house fans and programmable thermostat | 17,248 | 4,102 | 139 | 272 | 411 | 3.8 | 4.2 |
| ECIP Project No. 5 Multiple ECO's : 1 to 4 | 47,118 | 13,930 | 560 | 672 | 1,232 | 4.6 | 3.4 |
| RIVER VILLAGE 1600 AREA (188 Units) | | | | | | | |
| ECIP Project No. 6: 1. Replace 3 light fixtures with Fluorescent type | 66,326 | 11,280 | 661 | (-)63 | 598 | 2.5 | 5.9 |
| ECIP Project No. 7: 1. Activate whole house fans and install programmable thermostat | 238,564 | 46,582 | 2,435 | 621 | 3,056 | 2.8 | 5.1 |

4. ECIP Projects Developed

Per the direction of the Installation, seven(7) ECO packages have been developed based on ECIP project guidelines, as follows. **ECIP Nos. 6 and 7**, both for River Village 1600 Area, if combined, would exceed \$300,000 in cost. They are therefore packaged separately.

ECIP No. 1: Gerber Village 100 Areas with no basement (22 units)

- Insulate exterior walls
- Insulate over crawl space
- Replace 3 incandescent light fixtures with high efficiency fluorescent type
- Reactivate existing whole house fans
- Install programmable thermostats

ECIP No. 2: Gerber Village 100 Areas with basement (36 units)

- Insulate exterior walls
- Insulate over crawl space
- Replace 3 incandescent light fixtures with high efficiency fluorescent type
- Reactivate existing whole house fans
- Install programmable thermostats

ECIP No. 3: 166-171 Area (12 units)

- Insulate exterior walls
- Insulate over crawl space
- Replace 3 incandescent light fixtures with high efficiency fluorescent type
- Install new whole house fans
- Install programmable thermostats

ECIP No. 4: T-400 Area "T"-shape Houses (20 units)

- Replace 3 incandescent light fixtures with high efficiency fluorescent type
- Install new whole house fans
- Install programmable thermostats
- Insulate domestic water heaters

ECIP No. 5: T-400 Area "L"-shape Houses (14 units)

- Insulate over crawl space

- Replace 3 incandescent light fixtures with high efficiency fluorescent type
- Install new whole house fans
- Install programmable thermostats
- Insulate domestic water heaters

ECIP No. 6: River Village 1600 Area (188 units)

- Replace 3 incandescent light fixtures with high efficiency fluorescent type

ECIP No. 7: River Village 1600 Area (188 units)

- Install new whole house fans
- Install programmable thermostats

The 'Life Cycle Cost Analysis Summary - Energy Conservation Investment Program (ECIP)' for each ECIP is attached herein as well as in Appendix I.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 5
 PROJECT TITLE: Housing Insulation Study (ECO) FISCAL YEAR 95
 DISCRETE PORTION NAME: Gerber Village 100 Area - No Basement: Multiple ECO's ECIP No. 1
 ANALYSIS DATE: Jan '95 ECONOMIC LIFE 20 PREPARER EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

| | |
|--|-------------------|
| A. CONSTRUCTION COST | \$ <u>120,714</u> |
| B. SIOH | \$ <u>7,243</u> |
| C. DESIGN COST | \$ <u>7,243</u> |
| D. TOTAL COST (1A+1B+1C) | \$ <u>135,200</u> |
| E. SALVAGE VALUE OF EXISTING EQUIPMENT | \$ <u>-0-</u> |
| F. PUBLIC UTILITY COMPANY REBATE | \$ <u>-0-</u> |
| G. TOTAL INVESTMENT (1D-1E-1F) | \$ <u>135,200</u> |

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (BOD Oct 1994) DISCOUNT RATE: 3.1%

| ENERGY SOURCE | COST \$/MBTU(1) | SAVINGS MBTU/YR(2) | ANNUAL \$ SAVINGS(3) | DISCOUNT FACTOR(4) | DISCOUNTED SAVINGS(5) |
|-------------------|-----------------|--------------------|----------------------|--------------------|-----------------------|
| A. ELEC | \$ <u>17.58</u> | <u>1,203</u> | \$ <u>21,174</u> | <u>15.61</u> | \$ <u>330,526</u> |
| B. DIST | \$ _____ | _____ | \$ _____ | _____ | \$ _____ |
| C. RESID | \$ _____ | _____ | \$ _____ | _____ | \$ _____ |
| D. NG | \$ <u>6.079</u> | <u>1,153</u> | \$ <u>7,009</u> | <u>20.96</u> | \$ <u>146,908</u> |
| G. OTHER | \$ _____ | _____ | \$ _____ | _____ | \$ _____ |
| H. DEMAND SAVINGS | | | \$ _____ | _____ | \$ _____ |
| I. TOTAL | | <u>2,557</u> | \$ <u>28,183</u> | | \$ <u>477,434</u> |

3. NON-ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-) \$ _____
 (1) DISCOUNT FACTOR (TABLE A) _____
 (2) DISCOUNTED SAVINGS/COST (3A X 3A1) \$ 0

B. NON-RECURRING SAVINGS (+) OR COST (-)

| ITEM | SAVINGS (+) COST (-) (1) | YEAR OF OCCUR. (2) | DISCOUNT FACTOR(3) | DISCOUNTED SAVINGS/ (+COST(+/-)(4) |
|----------|-----------------------------|-----------------------|-----------------------|---------------------------------------|
| a. _____ | \$ _____ | _____ | _____ | \$ _____ |
| b. _____ | \$ _____ | _____ | _____ | \$ _____ |
| c. _____ | \$ _____ | _____ | _____ | \$ _____ |
| d. TOTAL | \$ _____ | | | \$ <u>0</u> |

C. TOTAL NON -ENERGY DISCOUNTED SAVINGS (3A2+3B4d) \$ 0

4. FIRST YEAR DOLLAR SAVINGS (2I3+(3Bd1/YRS ECON LIFE)): \$ 32,748
 5. SIMPLE PAYBACK (1G/4): 4.8 YEARS
 6. TOTAL NET DISCOUNTED SAVINGS (2I5 + 3C): \$ 477,434
 7. SAVINGS TO INVESTMENT RATIO (SIR) 6/1G: 3.5

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 5
 PROJECT TITLE: Housing Insulation Study (ECO) FISCAL YEAR 95
 DISCRETE PORTION NAME: Gerber Village 100 Area - With Basement: Multiple ECO's ECIP No. 2
 ANALYSIS DATE: Jan '95 ECONOMIC LIFE 20 PREPARER EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

| | |
|--|-------------------|
| A. CONSTRUCTION COST | \$ <u>168,480</u> |
| B. SIOH | \$ <u>10,109</u> |
| C. DESIGN COST | \$ <u>10,109</u> |
| D. TOTAL COST (1A+1B+1C) | \$ <u>188,698</u> |
| E. SALVAGE VALUE OF EXISTING EQUIPMENT | \$ <u>-0-</u> |
| F. PUBLIC UTILITY COMPANY REBATE | \$ <u>-0-</u> |
| G. TOTAL INVESTMENT (1D-1E-1F) | \$ <u>188,698</u> |

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (BOD Oct 1994) DISCOUNT RATE: 3.1%

| ENERGY SOURCE | COST \$/MBTU(1) | SAVINGS MBTU/YR(2) | ANNUAL \$ SAVINGS(3) | DISCOUNT FACTOR(4) | DISCOUNTED SAVINGS(5) |
|-------------------|-----------------|--------------------|----------------------|--------------------|-----------------------|
| A. ELEC | \$ <u>17.58</u> | <u>2,092</u> | \$ <u>36,775</u> | <u>15.61</u> | \$ <u>574,094</u> |
| B. DIST | \$ _____ | _____ | \$ _____ | _____ | \$ _____ |
| C. RESID | \$ _____ | _____ | \$ _____ | _____ | \$ _____ |
| D. NG | \$ <u>6.079</u> | <u>2,221</u> | \$ <u>13,501</u> | <u>20.96</u> | \$ <u>282,990</u> |
| G. OTHER | \$ _____ | _____ | \$ _____ | _____ | \$ _____ |
| H. DEMAND SAVINGS | | | \$ _____ | _____ | \$ _____ |
| I. TOTAL | | <u>4,313</u> | \$ <u>50,276</u> | | \$ <u>857,084</u> |

3. NON-ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-) \$ _____
 (1) DISCOUNT FACTOR (TABLE A) _____
 (2) DISCOUNTED SAVINGS/COST (3A X 3A1) \$ 0

B. NON-RECURRING SAVINGS (+) OR COST (-)

| ITEM | SAVINGS (+) COST (-) (1) | YEAR OF OCCUR. (2) | DISCOUNT FACTOR(3) | DISCOUNTED SAVINGS/ (+/-)COST(4) |
|----------|-----------------------------|-----------------------|-----------------------|-------------------------------------|
| a. _____ | \$ _____ | _____ | _____ | \$ _____ |
| b. _____ | \$ _____ | _____ | _____ | \$ _____ |
| c. _____ | \$ _____ | _____ | _____ | \$ _____ |
| d. TOTAL | \$ _____ | | | \$ <u>0</u> |

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (3A2+3B4d) \$ 0

4. FIRST YEAR DOLLAR SAVINGS (2I3+(3Bd1/YRS ECON LIFE)): \$ 50,276
 5. SIMPLE PAYBACK (1G/4): 3.8 YEARS
 6. TOTAL NET DISCOUNTED SAVINGS (2I5 + 3C): \$ 857,084
 7. SAVINGS TO INVESTMENT RATIO (SIR) 6/1G: 4.4

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 5
 PROJECT TITLE: Housing Insulation Study (ECO) FISCAL YEAR 95 ECIP No. 3
 DISCRETE PORTION NAME: 166-171 Area: Multiple ECO's
 ANALYSIS DATE: Jan '95 ECONOMIC LIFE 20 PREPARER EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

| | | |
|--|------------------|------------------|
| A. CONSTRUCTION COST | \$ <u>51,276</u> | |
| B. SIOH | \$ <u>3,076</u> | |
| C. DESIGN COST | \$ <u>3,076</u> | |
| D. TOTAL COST (1A+1B+1C) | \$ <u>57,429</u> | |
| E. SALVAGE VALUE OF EXISTING EQUIPMENT | \$ <u>-0-</u> | |
| F. PUBLIC UTILITY COMPANY REBATE | \$ <u>-0-</u> | |
| G. TOTAL INVESTMENT (1D-1E-1F) | | \$ <u>57,429</u> |

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (BOD Oct 1994) DISCOUNT RATE: 3.1%

| ENERGY SOURCE | COST \$/MBTU(1) | SAVINGS MBTU/YR(2) | ANNUAL \$ SAVINGS(3) | DISCOUNT FACTOR(4) | DISCOUNTED SAVINGS(5) |
|-------------------|-----------------|--------------------|----------------------|--------------------|-----------------------|
| A. ELEC | \$ <u>17.58</u> | <u>475</u> | \$ <u>8,354</u> | <u>15.61</u> | \$ <u>130,351</u> |
| B. DIST | \$ _____ | _____ | \$ _____ | _____ | \$ _____ |
| C. RESID | \$ _____ | _____ | \$ _____ | _____ | \$ _____ |
| D. NG | \$ <u>6.079</u> | <u>316</u> | \$ <u>1,922</u> | <u>20.96</u> | \$ <u>40,263</u> |
| G. OTHER | \$ _____ | _____ | \$ _____ | _____ | \$ _____ |
| H. DEMAND SAVINGS | | | \$ _____ | _____ | \$ _____ |
| I. TOTAL | | <u>791</u> | \$ <u>10,176</u> | | \$ <u>170,624</u> |

3. NON-ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-) \$ _____
 (1) DISCOUNT FACTOR (TABLE A) _____
 (2) DISCOUNTED SAVINGS/COST (3A X 3A1) \$ 0

B. NON-RECURRING SAVINGS (+) OR COST (-)

| ITEM | SAVINGS (+) COST (-) (1) | YEAR OF OCCUR. (2) | DISCOUNT FACTOR(3) | DISCOUNTED SAVINGS/ (+)-COST(+/-)(4) |
|----------|-----------------------------|-----------------------|-----------------------|---|
| a. _____ | \$ _____ | _____ | _____ | \$ _____ |
| b. _____ | \$ _____ | _____ | _____ | \$ _____ |
| c. _____ | \$ _____ | _____ | _____ | \$ _____ |
| d. TOTAL | \$ _____ | | | \$ <u>0</u> |

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (3A2+3B4d) \$ 0

4. FIRST YEAR DOLLAR SAVINGS (2I3+(3Bd1/YRS ECON LIFE)) \$ 10,176
 5. SIMPLE PAYBACK (1G/4): 5.6 YEARS
 6. TOTAL NET DISCOUNTED SAVINGS (2I5 + 3C): \$ 170,624
 7. SAVINGS TO INVESTMENT RATIO (SIR) 6/1G: 2.7

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 5
 PROJECT TITLE: Housing Insulation Study (ECO) FISCAL YEAR 95
 DISCRETE PORTION NAME: T-400 Area "T"-shape units: Multiple ECO's ECIP No. 4
 ANALYSIS DATE: Jan '95 ECONOMIC LIFE 20 PREPARER EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

| | |
|--|------------------|
| A. CONSTRUCTION COST | \$ <u>29,804</u> |
| B. SIOH | \$ <u>1,788</u> |
| C. DESIGN COST | \$ <u>1,788</u> |
| D. TOTAL COST (1A+1B+1C) | \$ <u>33,380</u> |
| E. SALVAGE VALUE OF EXISTING EQUIPMENT | \$ <u>-0-</u> |
| F. PUBLIC UTILITY COMPANY REBATE | \$ <u>-0-</u> |
| G. TOTAL INVESTMENT (1D-1E-1F) | \$ <u>33,380</u> |

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (BOD Oct 1994) DISCOUNT RATE: 3.1%

| ENERGY SOURCE | COST \$/MBTU(1) | SAVINGS MBTU/YR(2) | ANNUAL \$ SAVINGS(3) | DISCOUNT FACTOR(4) | DISCOUNTED SAVINGS(5) |
|-------------------|----------------------|--------------------|----------------------|--------------------|-----------------------|
| A. ELEC | \$ <u>17.58</u> | <u>421</u> | \$ <u>7,401</u> | <u>15.61</u> | \$ <u>115,532</u> |
| B. DIST | \$ <u> </u> | <u> </u> | \$ <u> </u> | <u> </u> | \$ <u> </u> |
| C. RESID | \$ <u> </u> | <u> </u> | \$ <u> </u> | <u> </u> | \$ <u> </u> |
| D. NG | \$ <u>6.079</u> | <u>175</u> | \$ <u>1,064</u> | <u>20.96</u> | \$ <u>22,298</u> |
| G. OTHER | \$ <u> </u> | <u> </u> | \$ <u> </u> | <u> </u> | \$ <u> </u> |
| H. DEMAND SAVINGS | | | \$ <u> </u> | <u> </u> | \$ <u> </u> |
| I. TOTAL | | <u>596</u> | \$ <u>8,465</u> | | \$ <u>137,830</u> |

3. NON-ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-) \$
 (1) DISCOUNT FACTOR (TABLE A)
 (2) DISCOUNTED SAVINGS/COST (3A X 3A1) \$ 0

B. NON-RECURRING SAVINGS (+) OR COST (-)

| ITEM | SAVINGS (+) COST (-) (1) | YEAR OF OCCUR. (2) | DISCOUNT FACTOR(3) | DISCOUNTED SAVINGS/ (+)COST(+/-)(4) |
|----------------------|--------------------------|--------------------|--------------------|-------------------------------------|
| a. <u> </u> | \$ <u> </u> | <u> </u> | <u> </u> | \$ <u> </u> |
| b. <u> </u> | \$ <u> </u> | <u> </u> | <u> </u> | \$ <u> </u> |
| c. <u> </u> | \$ <u> </u> | <u> </u> | <u> </u> | \$ <u> </u> |
| d. TOTAL | \$ <u> </u> | | | \$ <u>0</u> |

C. TOTAL NON -ENERGY DISCOUNTED SAVINGS (3A2+3B4d) \$ 0

4. FIRST YEAR DOLLAR SAVINGS (2I3+(3Bd1/YRS ECON LIFE): \$ 8,465
 5. SIMPLE PAYBACK (1G/4): 3.9 YEARS
 6. TOTAL NET DISCOUNTED SAVINGS (2I5 + 3C): \$ 137,830
 7. SAVINGS TO INVESTMENT RATIO (SIR) 6/1G: 3.8

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 5
 PROJECT TITLE: Housing Insulation Study (ECO) FISCAL YEAR 95
 DISCRETE PORTION NAME: T-400 Area "L"-shape units: Multiple ECO's ECIP No. 5
 ANALYSIS DATE: Jan '95 ECONOMIC LIFE 20 PREPARER EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

| | |
|--|------------------|
| A. CONSTRUCTION COST | \$ <u>42,069</u> |
| B. SIOH | \$ <u>2,524</u> |
| C. DESIGN COST | \$ <u>2,524</u> |
| D. TOTAL COST (1A+1B+1C) | \$ <u>47,118</u> |
| E. SALVAGE VALUE OF EXISTING EQUIPMENT | \$ <u>-0-</u> |
| F. PUBLIC UTILITY COMPANY REBATE | \$ <u>-0-</u> |
| G. TOTAL INVESTMENT (1D-1E-1F) | \$ <u>47,118</u> |

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (BOD Oct 1994) DISCOUNT RATE: 3.1%

| ENERGY SOURCE | COST \$/MBTU(1) | SAVINGS MBTU/YR(2) | ANNUAL \$ SAVINGS(3) | DISCOUNT FACTOR(4) | DISCOUNTED SAVINGS(5) |
|-------------------|-----------------|--------------------|----------------------|--------------------|-----------------------|
| A. ELEC | \$ <u>17.58</u> | <u>560</u> | \$ <u>9,845</u> | <u>15.61</u> | \$ <u>153,677</u> |
| B. DIST | \$ _____ | _____ | \$ _____ | _____ | \$ _____ |
| C. RESID | \$ _____ | _____ | \$ _____ | _____ | \$ _____ |
| D. NG | \$ <u>6.079</u> | <u>672</u> | \$ <u>4,085</u> | <u>20.96</u> | \$ <u>85,623</u> |
| G. OTHER | \$ _____ | _____ | \$ _____ | _____ | \$ _____ |
| H. DEMAND SAVINGS | | | \$ _____ | _____ | \$ _____ |
| I. TOTAL | | <u>1,232</u> | \$ <u>13,930</u> | | \$ <u>239,300</u> |

3. NON-ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-) \$ _____
 (1) DISCOUNT FACTOR (TABLE A) _____
 (2) DISCOUNTED SAVINGS/COST (3A X 3A1) \$ 0

B. NON-RECURRING SAVINGS (+) OR COST (-)

| ITEM | SAVINGS (+) COST (-) (1) | YEAR OF OCCUR. (2) | DISCOUNT FACTOR(3) | DISCOUNTED SAVINGS/ (+)COST(+/-)(4) |
|----------|--------------------------|--------------------|--------------------|-------------------------------------|
| a. _____ | \$ _____ | _____ | _____ | \$ _____ |
| b. _____ | \$ _____ | _____ | _____ | \$ _____ |
| c. _____ | \$ _____ | _____ | _____ | \$ _____ |
| d. TOTAL | \$ _____ | | | \$ <u>0</u> |

C. TOTAL NON -ENERGY DISCOUNTED SAVINGS (3A2+3B4d) \$ 0

4. FIRST YEAR DOLLAR SAVINGS (2I3+(3Bd1/YRS ECON LIFE): \$ 13,930
 5. SIMPLE PAYBACK (1G/4): 3.4 YEARS
 6. TOTAL NET DISCOUNTED SAVINGS (2I5 + 3C): \$ 239,300
 7. SAVINGS TO INVESTMENT RATIO (SIR) 6/1G: 4.6

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 5
 PROJECT TITLE: Housing Insulation Study (ECO) FISCAL YEAR 95
 DISCRETE PORTION NAME: River Village 1600 Area: Replace 3 Light Fixtures with Fluorescent type ECIP No. 6
 ANALYSIS DATE: Jan '95 ECONOMIC LIFE 20 PREPARER EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

| | |
|--|------------------|
| A. CONSTRUCTION COST | \$ <u>59,220</u> |
| B. SIOH | \$ <u>3,553</u> |
| C. DESIGN COST | \$ <u>3,553</u> |
| D. TOTAL COST (1A+1B+1C) | \$ <u>66,326</u> |
| E. SALVAGE VALUE OF EXISTING EQUIPMENT | \$ <u>-0-</u> |
| F. PUBLIC UTILITY COMPANY REBATE | \$ <u>-0-</u> |
| G. TOTAL INVESTMENT (1D-1E-1F) | \$ <u>66,326</u> |

2. ENERGY SAVINGS (+)/COST (-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (BOD Oct 1994) DISCOUNT RATE: 3.1%

| ENERGY SOURCE | COST \$/MBTU(1) | SAVINGS MBTU/YR(2) | ANNUAL \$ SAVINGS(3) | DISCOUNT FACTOR(4) | DISCOUNTED SAVINGS(5) |
|-------------------|------------------|--------------------|----------------------|--------------------|-----------------------|
| A. ELEC | \$ <u>17.58</u> | <u>661</u> | \$ <u>11,620</u> | <u>15.61</u> | \$ <u>181,394</u> |
| B. DIST | \$ <u> </u> | <u> </u> | \$ <u> </u> | <u> </u> | \$ <u> </u> |
| C. RESID | \$ <u> </u> | <u> </u> | \$ <u> </u> | <u> </u> | \$ <u> </u> |
| D. NG | \$ <u>6.079</u> | <u>(-) 63</u> | \$ <u>(-) 383</u> | <u>20.96</u> | \$ <u>(-) 8,027</u> |
| G. OTHER | \$ <u> </u> | <u> </u> | \$ <u> </u> | <u> </u> | \$ <u> </u> |
| H. DEMAND SAVINGS | | | \$ <u> </u> | <u> </u> | \$ <u> </u> |
| I. TOTAL | | <u>598</u> | \$ <u>11,280</u> | | \$ <u>173,367</u> |

3. NON-ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-) \$
 (1) DISCOUNT FACTOR (TABLE A)
 (2) DISCOUNTED SAVINGS/COST (3A X 3A1) \$ 0

B. NON-RECURRING SAVINGS (+) OR COST (-)

| ITEM | SAVINGS (+) COST (-) (1) | YEAR OF OCCUR. (2) | DISCOUNT FACTOR(3) | DISCOUNTED SAVINGS/ (+)/COST(+/-)(4) |
|------------------|-----------------------------|-----------------------|-----------------------|---|
| a. <u> </u> | \$ <u> </u> | <u> </u> | <u> </u> | \$ <u> </u> |
| b. <u> </u> | \$ <u> </u> | <u> </u> | <u> </u> | \$ <u> </u> |
| c. <u> </u> | \$ <u> </u> | <u> </u> | <u> </u> | \$ <u> </u> |
| d. TOTAL | \$ <u> </u> | | | \$ <u>0</u> |

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (3A2+3B4d) \$ 0

4. FIRST YEAR DOLLAR SAVINGS (2I3+(3Bd1/YRS ECON LIFE): \$ 11,280
 5. SIMPLE PAYBACK (1G/4): 5.9 YEARS
 6. TOTAL NET DISCOUNTED SAVINGS (2I5 + 3C): \$ 173,367
 7. SAVINGS TO INVESTMENT RATIO (SIR) 6/1G: 2.5

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 5
 PROJECT TITLE: Housing Insulation Study (ECO) FISCAL YEAR 95
 DISCRETE PORTION NAME: River Village 1600 Area: Install Whole House Fans & Prog. Thermostats ECIP No. 7
 ANALYSIS DATE: Jan '95 ECONOMIC LIFE 20 PREPARER EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

| | |
|--|-------------------|
| A. CONSTRUCTION COST | \$ <u>213,003</u> |
| B. SIOH | \$ <u>12,780</u> |
| C. DESIGN COST | \$ <u>12,780</u> |
| D. TOTAL COST (1A+1B+1C) | \$ <u>238,564</u> |
| E. SALVAGE VALUE OF EXISTING EQUIPMENT | \$ <u>-0-</u> |
| F. PUBLIC UTILITY COMPANY REBATE | \$ <u>-0-</u> |
| G. TOTAL INVESTMENT (1D-1E-1F) | \$ <u>238,564</u> |

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (BOD Oct 1994) DISCOUNT RATE: 3.1%

| ENERGY SOURCE | COST \$/MBTU(1) | SAVINGS MBTU/YR(2) | ANNUAL \$ SAVINGS(3) | DISCOUNT FACTOR(4) | DISCOUNTED SAVINGS(5) |
|-------------------|----------------------|--------------------|----------------------|--------------------|-----------------------|
| A. ELEC | \$ <u>17.58</u> | <u>2,435</u> | \$ <u>42,807</u> | <u>15.61</u> | \$ <u>668,222</u> |
| B. DIST | \$ <u> </u> | <u> </u> | \$ <u> </u> | <u> </u> | \$ <u> </u> |
| C. RESID | \$ <u> </u> | <u> </u> | \$ <u> </u> | <u> </u> | \$ <u> </u> |
| D. NG | \$ <u>6.079</u> | <u>621</u> | \$ <u>3,775</u> | <u>20.96</u> | \$ <u>79,125</u> |
| G. OTHER | \$ <u> </u> | <u> </u> | \$ <u> </u> | <u> </u> | \$ <u> </u> |
| H. DEMAND SAVINGS | | | \$ <u> </u> | <u> </u> | \$ <u> </u> |
| I. TOTAL | | <u>3,056</u> | \$ <u>46,582</u> | | \$ <u>747,347</u> |

3. NON-ENERGY SAVINGS (+) OR COST (-):

| | |
|--|----------------------|
| A. ANNUAL RECURRING (+/-) | \$ <u> </u> |
| (1) DISCOUNT FACTOR (TABLE A) | <u> </u> |
| (2) DISCOUNTED SAVINGS/COST (3A X 3A1) | \$ <u>0</u> |

B. NON-RECURRING SAVINGS (+) OR COST (-)

| ITEM | SAVINGS (+) COST (-) (1) | YEAR OF OCCUR. (2) | DISCOUNT FACTOR(3) | DISCOUNTED SAVINGS/ (+COST(+/-)(4) |
|----------------------|-----------------------------|-----------------------|-----------------------|---------------------------------------|
| a. <u> </u> | \$ <u> </u> | <u> </u> | <u> </u> | \$ <u> </u> |
| b. <u> </u> | \$ <u> </u> | <u> </u> | <u> </u> | \$ <u> </u> |
| c. <u> </u> | \$ <u> </u> | <u> </u> | <u> </u> | \$ <u> </u> |
| d. TOTAL | \$ <u> </u> | | | \$ <u>0</u> |

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (3A2+3B4d) \$ 0

| | |
|---|-------------------|
| 4. FIRST YEAR DOLLAR SAVINGS (2I3+(3Bd1/YRS ECON LIFE): | \$ <u>46,582</u> |
| 5. SIMPLE PAYBACK (1G/4): | <u>5.1</u> YEARS |
| 6. TOTAL NET DISCOUNTED SAVINGS (2I5 + 3C): | \$ <u>747,347</u> |
| 7. SAVINGS TO INVESTMENT RATIO (SIR) 6/1G: | <u>2.8</u> |

5. Operational or Policy Change Recommendations

No operational or policy change is recommended for the housing units studied. Existing policy of the Housing Office has served the Installation well, and there is no compelling reason to change it.

D. ENERGY AND COST SAVINGS

See TABLE 2 for the following:

1. Projected energy and energy cost savings and
2. Projected percentage of energy saved.

TABLE 2: ENERGY AND ENERGY COST SAVINGS SUMMARY
(Total of all six housing groups)

| Category | Existing Energy Consumption/Cost | Projected Energy Consumption/Cost | Savings in Energy/Cost: | Savings in Energy/Cost: |
|-------------------------|----------------------------------|-----------------------------------|-------------------------|--------------------------|
| | | | Quantity | % |
| <u>Energy/Year:</u> | | | | |
| Electricity (MBtu) | 30,014 | 22,039 | 7,975 | 26.6 |
| Gas (MBtu) | 23,789 | 18,603 | 5,186 | 21.8 |
| Total (MBtu) | 53,803 | 40642 | 13,161 | 24.5 (average) |
| <u>Energy Cost/Yr..</u> | | | | |
| Dollars (\$) | 689,452 | 517,766 | 171,686 | 24.9 |

NOTES:

1. Utility costs based on \$ 17.575/MBtu (\$ 0.06/kWh) for electricity, \$ 6.082/MBtu (\$ 0.68/therm) for natural gas.
2. Projected savings based on implementation of all seven(7) ECIP projects.